College of Tropical Agriculture
and Human Resources
University of Hawai'i at Mānoa

Insect Pests
June 2012
IP-29

Ant Damage to Banana Fruits by Abdominal Secretions

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Some ants can directly damage plants and agricultural commodities (Peng and Christian 2007); at least two species of ants in Hawai'i damage the skin of banana fruits with their abdominal secretions. These ants spray their secretions to protect sap-feeding insects, from which they derive sweet, nutritious honeydew. The foraging ants may also enter a self-defense mode and spray secretions if disturbed by banana cultivation practices that jar the banana plant, or if they are startled when pesticide sprays impact the banana bunches. The marks and scars caused by their secretions, although they are cosmetic and do not affect the fruit pulp, can make the fruits unmarketable. Here we discuss the ants and the damage they cause to bananas, and suggest integrated management practices to reduce or avoid costly injury.

Hawaiian apple banana (Dwarf Brazilian 'Santa Catarina' variety) fruits with the typical symptoms of formic acid injury caused by ants. Also shown along the upper edge of the center fruit is a slight "corky scab" injury caused by the feeding of flower thrips (*Thrips hawaiiensis*). The thrips injury, although similar in color, is raised and corky in texture, not smooth and sunken as with formic acid injury.

Ants belong to the family Formicidae, from the Latin word *formica*, meaning *ant*. They are arthropods in the order Hymenoptera, an order that also includes sawflies, bees, and wasps. Ant species in the subfamily Formicinae produce formic acid (methanoic acid), which has the chemical formula HCOOH or HCO_2H. This subfamily of ants uses formic acid, which they eject or spray from an acidopore located at the end of the abdomen, to attack other animals and for self-defense. Formic acid is the simplest carboxylic acid and one of the strongest acids known, with a pH between 2 and 3. It can produce painful injuries to human skin, causing skin burns and eye irritation of fieldworkers. In Hawai'i, the ant species that produce formic acid are *Anoplolepis gracilipes; Paratrechina longicornis*; *Plagiolepis allaudi*; *Nylanderia vaga*; *Nylanderia bourbonica*; *Lepisiota* hi01; *Camponotus variegatus*, and *Brachymyrmex obscurior.*

On the east side of the Big Island, the ant most commonly associated with banana damage is the yellow crazy ant, *A. gracilipes*. In Hawai'i, this ant is also known as the longlegged ant. Crazy ants have a broad diet. They prey on a variety of arthropods, reptiles, birds, and mammals at soil level and within plant canopies. These sweet-loving pests also feed on plant nectars, and they farm and protect sap-feeding insects, including aphids, scales, and mealybugs (Abbott et al. 2012). They infest

Published by the College of Tropical Agriculture and Human Resources (CTAHR) and issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, under the Director/Dean, Cooperative Extension Service/CTAHR, University of Hawai'i at Mānoa, Honolulu, Hawai'i 96822.

Ants that produce formic acid are attracted to flower nectaries and to sap-feeding insects that secrete honeydew. They climb the plants to feed and, when startled, eject formic acid from their abdomens, causing blackened spots and trails.

Entire bunches may be damaged by formic acid injury.

Startled and disturbed ants scatter over the banana fingers, spraying formic acid and leaving burnt, sunken trails.

Severe formic acid injury to a hand of bananas in East Hawai‘i caused by *Anoplolepis gracilipes*.

banana bunches to feed at flower nectaries and on honeydew secreted by sap-feeding arthropods.

When they eject formic acid for offensive or defensive purposes, damage to agricultural crops can also occur. *A. gracilipes* can cause cosmetic, or superficial, but nonetheless significant damage to banana fruit bunches when their colonies are disturbed or agitated by bunch spraying with pesticides or when banana pseudostems receive vibrations through contact with humans or tractors. The startled, disturbed ants scramble around, spraying formic acid as they run, which burns the banana skins, leaving irregularly shaped, sunken, blackened lesions.

Another ant species—the white-footed ant, *Technomyrmex albipes*—caused similar fruit damage at a farm in Waimānalo. However, this canopy-nesting ant belongs to a different subfamily. These ants are dolichoderines, known for producing odiferous defensive compounds, some of which may be either acidic or damaging to plant tissues. This ant species mainly secretes benzaldehyde (Hayashi and Komae 1980), which presumably also damaged the banana skins.

Other ant species in the subfamily Formicinae in Hawai'i may also damage banana fruits. For example, *Plagiolepis alluaudi* is a very common ant in plant canopies, tending various Hemiptera. *Paratrechina longicornis* and possibly two *Nylanderia* species may also be associated with banana plants. The latter three species, however, are often outcompeted by a few of the more dominant ant species. They may, therefore, not be the main ant species tending sap-feeding insects or feeding at banana flower nectaries and thus not the species causing the primary damage. A further ant species, *Pheidole megacephala*, also tends various Hemipterous insects attracted to banana plants and nectaries, but it has not been observed damaging banana fruit.

Symptoms and Damage

The secretions of these ants create dark brown to charcoal-black trails and spots on the skins of banana fruits. The trails are irregular in shape and may be linear, curved, serpentine, or semi-circular, coinciding with the movement of the running, spraying ants. Spots may vary in size from 2 to 6 mm in diameter. The trails can be several millimeters wide and up to 12 mm long. All banana varieties are susceptible.

Affected fruits, and often whole bunches, produced at commercial banana farms in Hawai'i cannot be sold. They are destroyed in the field, resulting in an economic loss for each affected bunch. Since the edibility of the fruit is not affected, however, ant-damaged fruits may be found at farmers' markets in Hawai'i, though even here the value is reduced if injury is severe.

Management

When managing ant pests, suppression is preferable to eradication. Another ant species, perhaps an even worse pest, will usually colonize the niche vacated by an eradicated ant species. Suppression of an ant species can reduce pest injury to acceptable levels while allowing the ant to fill the ecological niche.

The following techniques are suggested for managing ants that damage banana fruits in Hawai'i. Also included is some of the rationale behind these approaches.

- Always identify the ant species before starting an ant-management program. Ant behavior, biology, ecology, and susceptibility to insecticides vary among species. For example, *T. albipes* can spread from plant to plant without contacting the ground, so ground-based treatments are not effective. Photographs and species descriptions are available at www.antweb.org (AntWeb 2012) or the Hawaii Ant Lab, www.littlefireants.com/index_files/ant_key.htm

- Confirm that ants are causing the observed damage. Some other insect pests of banana, such as thrips or moths, may cause feeding injuries that resemble the symptoms of formic acid injury caused by ants.

- Avoid disturbing the foraging ants within a banana bunch. Do not jar the ant colony by bumping into the banana pseudostem with your body or with tools or equipment. The ants perceive the jarring vibrations as a threat, causing them to disperse rapidly and spray trails of formic acid on fruits as they scatter. Reduce banana pesticide spraying operations where possible, as forceful sprays near bunches can disturb the ants.

- Control sap-feeding insects in the banana canopy, including aphids, scales, and mealybugs. This may include the application of insecticides.

Affected bunches are left in the field and are not harvested.

De-flowering the fingers on a banana bunch by plucking them off and severing the male flowers (the hanging "bell") will remove the sweet flower nectaries that attract sugar-loving ants in the subfamily Formicinae.

Fruits in bunches should be de-flowered to make them less attractive to foraging ants.

The flowers shown here may attract sweet-loving ants that may produce formic acid secretions when disturbed. This "bell" should be severed from the bunch.

- Use insecticidal baits as appropriate. For instance, they may not be effective in reducing or destroying colonies of *A. gracilipes*, as ant baits registered for banana in Hawai'i do not attract *A. gracilipes*. Test a small amount of your intended insecticidal bait to see if the ants will carry it back to their nest before applying it to a large area. Some organic and backyard growers may prefer to use plastic bait stations containing a boric acid solution, but this pesticide is not registered by the Hawai'i Department of Agriculture. *T. albipes* is difficult to control chemically because the workers do not carry food (or bait) back to the colony. Hence, baits must be very appealing to the ants so that large numbers of them will leave the nest and feed on the poisoned bait.

- Destroy nesting habitats for ants that produce formic acid. Pick up, remove, and compost plant litter such as banana leaves and fallen pseudostems, as ants such as *A. gracilipes* form nests beneath the litter (O'Dowd 2012). Periodically replace the old boric acid or other mixture with fresh bait.

- Scout areas around banana plants regularly for signs of ants. Smaller and more localized ant colonies are easier to control than larger infestations.

- Regularly de-flower young banana fingers and sever the male inflorescence (the "bell"). This will remove the flower nectaries and thereby make the young fruits less attractive to the sugar-loving ants that forage on the bunch. A ladder may be needed to reach the developing bunch.

- For canopy-nesting ants such as *T. albipes*, practice field sanitation (Tenbrink and Hara 1992). The removal of touching banana leaves between plants may slow the spread of the ant in the plantation.

- Another, potentially less harmful ant species that competes for the same ecological niche may naturally displace an injurious ant species over time. However, it may be unwise for growers to attempt to introduce a competing ant species to a farm or site without proper training and sufficient understanding of the potential ecological or social consequences, which could be dire.

Acknowledgements

The authors thank Fred Brooks and Paul Krushelnycky of UH-CTAHR for their thoughtful reviews of this manuscript.

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